

CLAIMS

What is claimed is:

1. An apparatus for co-registration of multi-modal images in a three-dimensional environment, the apparatus comprising:
 - a source of excitation light;
 - a one-way mirror having a transmissive side disposed towards the excitation light for transmitting the excitation light and a reflective side for reflecting light received from a target;
 - an electromagnetic-ray source disposed relative to the source of excitation light;
 - an electromagnetic-ray transparent mirror having a light-reflective surface disposed towards a reflecting side of the one-way mirror and an electromagnetic-ray transmissive surface disposed towards the electromagnetic-ray source;
 - a target location disposed towards the light-reflective surface of the electromagnetic-ray transparent mirror for locating a target and receiving the excitation light and the electromagnetic-rays;
 - an electromagnetic-ray detector disposed on an opposite side of the target location relative to the electromagnetic-ray source for detecting electromagnetic-rays transmitted through the target; and
 - a light detector disposed towards the reflective side of the one-way mirror for detecting light from the target.

2. An apparatus as defined in Claim 1 wherein the electromagnetic-ray source emits X-rays.

3. An apparatus as defined in Claim 1 wherein the source of excitation light emits at least one of optical, fluorescent, coherent, diffusive and transmissive light.

4. An apparatus as defined in Claim 1 wherein the light detector detects at least one of emitted and reflected light from the target.

5. An apparatus for co-registration of multi-modal images in a three-dimensional environment, the apparatus comprising:

a source of excitation light;

an electromagnetic-ray source disposed relative to the source of excitation light;

an electromagnetic-ray transparent mirror having a first surface disposed towards the excitation light and a second surface disposed towards the electromagnetic-ray source;

a target location disposed towards the first surface of the electromagnetic-ray transparent mirror for locating a target and receiving the excitation light and the electromagnetic rays;

an electromagnetic-ray detector disposed on an opposite side of the target location relative to the electromagnetic-ray transparent mirror for detecting electromagnetic-rays transmitted through the target;

a second electromagnetic-ray transparent mirror having a light-reflective surface disposed towards the target location; and

a light detector disposed towards the light-reflective surface of the second electromagnetic-ray transparent mirror for detecting light from the target.

6. An apparatus as defined in Claim 5 wherein the electromagnetic-ray source emits X-rays.

7. An apparatus as defined in Claim 5 wherein the source of excitation light emits at least one of optical, fluorescent, coherent, diffusive and transmissive light.

8. An apparatus as defined in Claim 5 wherein the light detector detects transmitted light from the target.

9. An apparatus as defined in Claim 5, further comprising a mirror disposed towards the excitation light for at least one of reflecting and redirecting the excitation light.

10. An apparatus as defined in Claim 5, further comprising a mirror disposed towards the light-reflective surface of the second electromagnetic-ray transparent mirror for at least one of reflecting and redirecting the light from the target to the light detector.

11. An apparatus as defined in Claim 5, further comprising at least one of gimbals and tracks for rotating the apparatus about a centrally disposed target.

12. A method for co-registration of multi-modal images in a three-dimensional environment, the method comprising:

defining a frame of reference;

providing electromagnetic-rays to a target relative to the frame of reference;

detecting electromagnetic-rays transmitted by the target relative to the frame of reference;

detecting light from the target relative to the frame of reference; and

providing co-registered electromagnetic-ray and light images of the target to a user.

13. A method as defined in Claim 12, further comprising redirecting the light to be detected from the target without redirecting the electromagnetic-rays to be detected from the target.

14. A method as defined in Claim 12, further comprising providing excitation light to the target relative to the frame of reference.

15. A method as defined in Claim 14, further comprising redirecting the excitation light relative to the target without redirecting the provided electromagnetic-rays.

16. A method as defined in Claim 12, further comprising:

capturing X-ray image data; and

identifying X-ray image data associated with the target.

17. A method as defined in Claim 14 wherein providing excitation light comprises:

converting image coordinates of the target into light coordinates for directing the excitation light; and

processing the light coordinates to direct the excitation light to the target in a real scene.

18. A program storage device readable by machine, tangibly embodying a program of instructions executable by the machine to perform program steps for co-registration of multi-modal images in a three-dimensional environment, the program steps comprising:

defining a frame of reference;

providing electromagnetic-rays to a target relative to the frame of reference;

detecting electromagnetic-rays transmitted by the target relative to the frame of reference;

detecting light from the target relative to the frame of reference; and

providing co-registered electromagnetic-ray and light images of the target to a user.

19. A program storage device as defined in Claim 18, the program steps further comprising redirecting the light to be detected from the target without redirecting the electromagnetic-rays to be detected from the target.

20. A program storage device as defined in Claim 18, the program steps further comprising providing excitation light to the target relative to the frame of reference.

21. A program storage device as defined in Claim 20, the program steps further comprising redirecting the excitation light relative to the target without redirecting the provided electromagnetic-rays.

22. A program storage device as defined in Claim 18, the program steps further comprising:

capturing X-ray image data; and

identifying X-ray image data associated with the target.

23. A program storage device as defined in Claim 20 wherein the program step of providing excitation light comprises:

converting image coordinates of the target into light coordinates for directing the excitation light; and

processing the light coordinates to direct the excitation light to the target in a real scene.